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FFTF SITE METEOROLOGY
PROGRESS REPORT #1
SEPTEMBER 1970

PREPARED FOR
THE UNITED STATES ATOMIC ENERGY COMMISSION
UNDER CONTRACT AT(45-1)-1830

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FFTF SITE METEOROLOGY
PROGRESS REPORT #1

by

H. G. Daubek

and

M. A. Wolf

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Atmospheric Resources Department
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September 1970

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FFTF SITE METEOROLOGY

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H. G. Daubek and M. A. Wolf

ABSTRACT

Studies of trajectories and diffusion and meteorological summaries show the differences in the values of meteorological parameters measured in and adjacent to the southern portion of the Hanford Reservation. Soundings of temperature, humidity, and wind velocity were made to supplement the horizontal network of sensors. Tetron trajectories were used to simulate the trajectories of air parcels. Tetron trajectories were consistent with motions expected from the temperature profiles and winds measured above the surface. The climatic studies show differences in wind velocity and temperature between the FFTF Site and other locations indicating direct extrapolation of some parameters over long distances on the Hanford Reservation is not practical.

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SUMMARY

Data collected at the FFTF Site and other locations in and adjacent to the southern portion of the Hanford Reservation during a special study, combined with standard wind measurements over a longer period, have been summarized and subjected to an analysis to initiate a description of the FFTF Site meteorology. The data show large differences frequently occur in the values of the meteorological data of the FFTF Site and the Hanford Meteorology Station (HMS) Tower.

Tetroons were released to simulate the trajectory of an air parcel. Tetroons released show the horizontal trajectory to be dependent upon the wind direction measured at the height of the tetroon. This height changed as the vertical air motions carried the tetroon up and down. The depth of the vertical convection indicated by the tetroon changed with variations in stability and ground cover.

Wind velocity measured at the FFTF Site and the HMS indicate large differences in wind velocity at the two locations. The spot checks on winds above the surface show the differences extend high above the surface. Wind direction distribution at the FFTF Site is bimodal while at the HMS there is only one predominant direction. The wind speeds at the FFTF Site are much less than those recorded at the HMS. The terrain influence on air flow is indicated by the differences in the wind directions between the sites used in the study.

Temperatures measured at the FFTF Site and a few miles to the northwest are cooler than those measured at the HMS.

INTRODUCTION

A better understanding of the meteorological characteristics of the FFTF Site is necessary to provide the meteorological definition required by the AEC for each nuclear reactor site. The characterization of the site meteorology goes beyond the development of an on-site climatology. Data summaries are frequently extrapolated to a second location or to the surrounding area of a site. The extrapolation frequently extends the data beyond its sphere of relevance ignoring the spatial and temporal variations in the atmosphere and producing errors in the subsequent analysis. Successful extrapolation is most likely in areas of uniform terrain and ground cover. An evaluation of the validity of extrapolated data may be made from the comparison of concurrent measurements at the two locations.

The study of site meteorology for the Fast Flux Test Facility (FFTF) was initiated to develop an on-site climatology and to determine the validity of an extrapolation of the meteorological data from the Hanford Meteorology Station (HMS) to the FFTF Site. A surface wind velocity sensor was installed at the Site to provide data for the summaries and comparisons with concurrent HMS data. Agreement of sensor data would indicate the suitability of applying data from the 400 ft HMS tower at the FFTF Site. Lack of agreement would dictate an increased FFTF Site measurements program, while providing initial on-site data.

The recognition of significant differences in the surface wind velocity between the FFTF Site and the HMS resulted in an expansion of the surface measurements to a network of sensors for the definition of the surface wind field. The objective of the comparison of FFTF Site data with

data from other nearby locations was to determine the presence of local influences on the meteorology at the FFTF Site.

Subsequently, special studies were conducted to provide measurements of vertical profiles of temperature, humidity and wind velocity to determine to what height the differences observed at the surface extended. An additional feature of the special studies was the tracking of tetroons, rigid balloons which float at a constant density level. These were flown to simulate the trajectory of effluent originating at the FFTF Site and, thus, determine the suitability of source-point meteorology for trajectory definition.

This report has been prepared to present the results of the comparisons of meteorological data from the FFTF and HMS, both at the surface and aloft. The data include measurements of estimated trajectories of air parcels passing over the FFTF Site, wind velocity and vertical profiles of temperature and humidity. The report includes the comparison of wind velocities in the expanded surface network with tetroon trajectories, a comparison of simultaneous wind direction measurements at the FFTF Site and other wind sensor locations, and an examination of meteorological parameters above the surface.

DATA COLLECTION AND REDUCTION

Data collected at six locations have been compiled for this summary. The locations, with their identifiers, are shown in Figure 1. Trajectories of air parcels passing over the FFTF Site were estimated from the trajectories of tetroons. Vertical profiles of wind, temperature

FIGURE 1. Location of Meteorological Sensors

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and humidity were measured up to about 5,000 ft MSL at two of the locations, the FFTF Site and the HMS, by free lift balloons and aircraft mounted sensors. The HMS Tower data is recorded from meteorological sensors mounted at multiple levels up to 400 ft above ground. The Northern Pacific Railway Company Tower has the wind sensors located 150 ft (Site 109) and 20 ft (Site 108) above ground. The anemometer at the Richland Airport (Site 112) is about 50 ft above ground and the other locations have the sensors on a short mast, about 12 ft above the terrain.

TETROON

Tetroons were released at or near the FFTF Site to simulate the trajectory of an air parcel released under similar meteorological conditions. A tetroom is a tetrahedron shaped rigid balloon. Two theodolites were used to track each tetroom and observations were made of the tetroom position each minute.

The tetroom was expected to follow the air currents at an elevation of about 250 to 300 meters (MSL). During the early flights excessively high flight altitudes were noted. Measurements confirmed that over pressure due to heating caused a small stretch of the mylar side. This caused the tetrooms to displace greater volume and travel at an average height greater than expected. Although the tetroom floated higher than expected, the observations still permitted an evaluation of the horizontal and vertical motions in the atmosphere.

Vertical plots for two of the tetroom flights T2012 and T2020, show the tetroom to be in flight below terrain levels. This effect is created at large distances by a slight error in the theodolite leveling.

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The maximum error noted was 60 meters on flight T2012. The terrain height is obtained from a USGS map with 20 ft contours and is assumed correct.

TEMPERATURE AND HUMIDITY PROFILES

The vertical profiles of temperature and humidity were measured for a comparison of the HMS and the FFTF Sites. The temperature profiles which are a measure of the atmospheric stability indicate the relative diffusion rates of the two locations. Profiles of temperature were measured by flying an aircraft mounted temperature and humidity sensors in multiple passes over the two sites. The measurements were made between 5,000 ft MSL and the surface.

The instrumentation used to measure and record the temperature and humidity is made by Metrodata Systems, Inc. The signal was recorded on magnetic tape which was later processed and tabulated for analysis. The accuracy is reported to be $\pm 0.5^{\circ}\text{C}$, and $\pm 2\%$. Humidity is presented in relative units, 0-10, in this report because the absolute calibration of the sensor appeared to be in error. Some profiles are missing as a result of equipment malfunctions.

PIBALS

Pibals were released simultaneously from the FFTF Site and the HMS to measure and compare the vertical profiles of wind velocity at the two sites. A pibal is a free lift balloon with a calculable rate of rise from which the average wind velocity over a layer of air may be determined.

In addition, the pibal information is useful in analysis of the tetroom trajectories where changes of trajectory direction may be due either to horizontal or vertical wind shear. Regions of strong shear which are revealed by pibals also are regions of enhanced diffusion.

A pibal was normally released and tracked before and after each release of a tetroom. Two theodolites were used to track the pibal at the FFTF Site and one at the HMS. Observations of the balloon position were made at 30 second intervals after release. The rate of rise of pibals was analyzed to determine that the rise rate used in calculating wind values from the single theodolite was correct. A comparison of the calculated and observed rise rates indicates reasonable agreement between the two.

SURFACE WIND MEASUREMENTS

Surface wind velocity measurements were made to establish a basis for the climatology at the FFTF Site, to provide comparative data for the wind velocity at the HMS and the FFTF Site, and to provide data for the evaluation of trajectories from the FFTF Site. The anemometers were of two types. The standard aerovane sensor was used to collect data at all levels on the HMS Tower and at the Richland Airport. The other anemometers used for data collection have the general characteristics of low threshold, and high sensitivity equivalent to the Beckman and Whitley W/S 101 "B Series". Strip chart recorders were used at all locations except 300N where paper punch tape was used to record data.

The data used for comparisons is for the period December 1969 through June 1970. This period of data was selected to make the record

length of all sites, compatible with that of the FFTF Site record which extends from late November 1969.

The wind direction data compiled for this summary has three different reduction methods. The hourly wind directions, except at HMS and 300N, were determined from the strip charts by averaging the last ten minutes of each hour and recording to the nearest 10°, i.e., a 36-point compass. A study of strip chart data was used to determine that 10 minutes was an appropriate time interval. A variable wind was defined for these observations as $\Delta\theta$ greater than 120° during the averaging interval. The data from 300N were recorded as short period averages each five minutes during the hour. The 300N wind direction data were then calculated to the nearest degree and all observations were used in the summaries. The HMS Tower data was averaged from strip charts over the total hour and wind direction was recorded as a 16-point compass.

SPECIAL STUDIES OF TRANSPORT AND DIFFUSION

The tetrons, pibals and aircraft soundings were used to observe the air motions and atmospheric stability that would transport and diffuse a pollutant. The horizontal and vertical projections of the trajectory of twenty-five tetron flights and the associated meteorological data are presented in Appendix A.

The tetron is used to simulate the trajectory of an air parcel. It is further assumed that the tetron follows the vertical and the horizontal air motions. There is a slight error in this assumption caused

by the lag in the response of the tetroom.* Each tetroom has a note attached requesting the finder to phone Battelle-Northwest and report the serial number, the time, date, and location of the tetroom found. Table I is a listing of the date of release and the cities nearest to where the tetrooms have been found. This information is used in estimating trajectories after the tetroom leaves the Hanford Reservation. As an example, a tetroom released in the 100N area during an earlier study was observed traveling southerly toward Rattlesnake Mountain and Richland, Washington. A phone call report later showed the trajectory had turned and carried the tetroom to Wanapum Village northwest of Hanford.

The profiles of the wind velocity may be used to estimate the trajectory and diffusion. The wind velocities observed from the pibal track may be compared to the tetroom trajectory to evaluate how well a tetroom follows a trajectory indicated by the wind velocity at the same level. The velocity profile may also be used to evaluate the wind shears which would diffuse an air parcel at the same height.

The vertical profiles of temperature are a measure of the stability and are used to estimate the diffusion rate. During most tests the lapse rate indicated an unstable atmosphere. The vertical convection as measured by tetrooms also showed large convective motions. When the temperature profiles indicated a stable atmosphere, the vertical motions indicated by the tetroom positions confirmed that there was little convection.

*W. H. Hoecker and J. K. Angell, "Effect of a Sudden Change in Terrain Height on the Three-Dimensional Low-Level Air Flow, as Estimated from Tetroom Flights", Monthly Weather Review, Vol. 97, No. 12, 845-849, December 1969.

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TABLE ITHE CITY NEAREST TO WHERE TETROONS HAVE BEEN FOUND

<u>Date of Release</u>	<u>City</u>
May 18*	Colfax, Washington
May 22	Garfield, Washington
June 2	Goldendale, Washington
June 5	Adams, Oregon
June 5	Richland, Washington
June 10	Craigmont, Idaho
June 15	Odessa, Washington
June 17	Prosser, Washington
June 22	Colville, Washington
June 22 or 24*	Kendrick, Idaho
June 24	Basin City, Washington
June 24	Cour d' Alene, Idaho
June 24	Winchester, Idaho
June 26	Prosser, Washington
Unknown*	Post Falls, Idaho

*Serial number not identified. Date of release based on date found.

The data are discussed by grouping into the climatically predominant feature of wind direction. During June the wind direction at the FFTF Site had large percentages of wind directions around 240° , 310° , and 360° , Figure 2. The high percentage at the direction of 360° may be related to strip chart recorder characteristics and chart reading. Tetron flights associated with these conditions are evaluated and the associated pibal, and aircraft data are presented to augment the analysis.

Other meteorological conditions are of interest because of their influence on the transport and diffusion of an effluent. Two of these are light or calm winds and changes in the mean wind direction. A change in the mean wind direction may be either synoptic or diurnal. Either condition causes changes in the transport and diffusion characteristics of the atmosphere. A light and variable wind or a calm situation is of interest because of the frequency with which they occur at the FFTF Site. These meteorological conditions are also discussed in the following sections.

SOUTHWEST WINDS

Wind directions from the southwest quadrant are prevalent at the FFTF Site. Tetron trajectories typical of such airflow occurred on June 15. Two tetrons and four simultaneous releases of pibals were tracked. No temperature data are available but humidity is included.

Both flights left the Hanford Reservation near Ringold Gap having fairly straight horizontal projections of the trajectories but varying height on the vertical projection of the trajectories.

FIGURE 2. Percent Frequency Distribution of Wind Direction, FFTF Site, June 1970.

Both tetrooms followed the average winds of the lower 500 m of pibal observations. An analysis of the surface sensor data indicates the sensors were not good indicators of the trajectory. A slight wind shift between runs is observed by noting the more northerly winds indicated by the surface sensors and the pibals. This wind shift may be indicative of a low level wind shear not noted on the pibals which would explain the poor correlation of surface sensors to the trajectory path. A northerly shift of wind can be observed in the pibal wind direction and this apparently affected the trajectory of tetroom flight 2012. Flight 2011 has a large bend which may be attributed to wind shear with height.

The tetroom trajectory curves into Ringold Gap in 2011 during a time that the tetroom had descended to a lower altitude. The terrain also may have had an influence on the wind at that level.

The vertical projections of the tetroom indicate vertical convection of a variable magnitude and the diffusion rate is probably similarly variable. Flight 2012 had a relatively level flight until a sudden rise in tetroom height which the horizontal projection shows was coincident with reaching the sand dunes. It is presumed that more intense heating of even small areas such as the sand dunes opposite Ringold Gap has a large effect on vertical convection. The final rise recorded on this tetroom flight may also be the influence of a change in ground cover. Different from other flights in the series, are the vertical projections of 2011 which illustrates one large eddy followed by smaller eddies later in the flight. No explanation can be made for this sequence.

WEST TO WEST-NORTHWEST WINDS

The trajectory of the tetroons under west and west-northwest wind directions is expected to be across the White Bluffs between Ringold Gap and the Hanford 300 Area. A significant feature of this wind direction sector is that a west wind carries a possible pollutant the shortest distance from the FFTF Site to a boundary of the Hanford Reservation and an uncontrolled population. There were two test days during the series of field tests that had winds from the west or just north of west, May 27 and June 29. During tests, T2026, 2027 and T2028, all on June 29, the trajectories cross the river, pass over the bluffs and are then over cultivated land. Four pibals and three sets of temperature soundings are also available for analysis from that day.

The horizontal projection of tetroon flights on June 29, 1970, are straight with some minor meandering apparently created by large eddies. During all tests the tetroon followed the wind observed in the lower levels of the atmosphere as measured by the pibals. The winds measured at the Richland Airport are observed to be a little south of west which is also measured in the lowest observations of the pibal flight. This southwest airflow apparently was underneath the tetroon flight. Wind velocity data is missing for the FFTF Site and the NP Tower during this period.

During two of the tetroon flights the vertical oscillations of the tetroon were so large as to mask any terrain effects. Flight T2027 did remain near the surface until the tetroon reached the river area, this

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may be from a combination of the rise in terrain and a change in ground cover.

WIND SHIFTS

Wind shifts or direction changes of the mean wind are usually considered as synoptic, caused by large scale pressure changes in the atmosphere; or diurnal, caused by local heating and cooling of the air. Wind shifts recorded on the Hanford Reservation during the summer months are usually diurnal in nature. Diurnal wind changes were noted during the field testing on June 22 and 24. The wind shift is readily observed from the HMS data as shown in Table II. Site 112, at the Richland Airport, shown in the same table, also indicates the wind shift, but the change is masked somewhat by observations of a variable wind direction Code 50.

The expected trajectory during a wind shift is somewhat unpredictable because the trajectory is aligned in one direction and then will make a sharp bend, or turn back on itself. Either situation creates a spread of pollutants beyond the area indicated by wind sensors at or near the source. The complex nature of a trajectory during a wind direction change is illustrated in Figure 3, a composite mapping of three tetron trajectories on June 24, 1970.

The surface wind during the first flight is NW at the HMS and SW at the FFTF Site. The tetron flew the standard trajectory toward Ringold of an air parcel during southwest winds at the FFTF Site and west. Shortly after the start of the second flight the wind shifted and eventually became

TABLE II
DIURNAL WINDSHIFTS
June 21-25, 1970

Time	Richland Airport		Richland Airport		Richland Airport		Richland Airport		Richland Airport	
	HMS	21	HMS	22	HMS	23	HMS	24	HMS	25
0100	3008	2805	3220	3403	2913	2705	2922	3106	4000	2303
0200	3309	2804	3013	5001	2906	4000	3018	5001	3204	4000
0300	3009	3101	2914	4000	2910	5001	3014	1803	2208	0604
0400	3310	0407	3010	5001	2607	1103	2917	5001	2001	0903
0500	3205	2803	3110	5001	3106	1304	3014	4000	2004	2402
0600	3108	3405	3014	4000	3009	1405	3313	4000	4000	4000
0700	3407	5001	3011	5001	3605	5001	3115	5003	0303	0805
0800	3209	1504	3208	2604	3605	0602	3012	5002	0702	4000
0900	3109	1505	3513	3008	3603	5002	3107	5004	1303	3405
1000	3307	1405	3506	5004	2804	1305	2702	1407	0502	3104
1100	0106	1508	0704	1409	0905	1305	1303	0906	1503	1109
1200	3407	0610	1808	0909	1103	0908	2305	1305	5003	0906
1300	0510	0514	5003	0910	0406	1107	1809	1203	1105	0705
1400	0610	0510	5004	0809	0610	5004	2413	2705	1007	0706
1500	0207	0309	1708	0811	1405	0908	2815	5001	1211	0809
1600	3607	0609	1006	0710	1606	5004	2410	5002	1211	0606
1700	3508	0408	1004	0610	1408	1008	2512	3409	0812	1208
1800	3507	1505	1010	0908	1407	1305	3220	3010	5002	1408
1900	3408	4000	1207	1505	2208	1512	3120	3225	1707	1601
2000	3017	2103	3007	0903	3020	2108	3018	3222	1613	1607
2100	3020	3009	3114	1301	3121	1815	3119	3409	1512	1604
2200	3117	5003	3015	3609	3120	1013	2914	3420	3108	1206
2300	3114	3408	3116	4000	3017	1010	3810	5001	3302	2114
2400	3219	3208	3116	2603	3018	1406	3308	5003	2506	2112

Data code is (XXYY) where XX is the wind direction to the nearest ten degrees and YY is the wind speed in mph. A wind direction code 50 represents a variable wind and code 40 represents calm.

southerly at the FFTF Site. The third tetron flight of the day shows the wind shift complete and the tetron is meandering to the NW of the FFTF Site toward the 200 East Area and later slowly turns toward Cold Creek Valley.

The pibal releases also display the wind shift, Figure 4. Although the surface wind direction at HMS and Site 112 were separated by a large direction difference at the start of the tetron flight the pibals aligned to the same wind direction very well after the first few minutes. One can observe the successive changes in wind direction illustrated in the sequential releases and a trend to return to a westerly wind on the last pibal release.

The vertical profiles also illustrate a significant feature of vertical convection. The vertical convection was very small during the first flight even though its path was over terrain and areas which had sustained large convective motions during previous tetron flights. The vertical profiles of temperature show an inversion existed above the tetron flight level in flight 2020. This apparently suppressed any major vertical motions. The vertical motion increased during the following flights, as noted in Figure 5, coincident with the increasingly unstable lapse rate.

NORTH WINDS

A critical sector within the study of effluents from a reactor is toward the zones of highest population. At the FFTF Site, this is a sector including the cities of Richland and Benton City.

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

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1	179.8
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Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

FIGURE 4. SIMULTANEOUSLY RELEASED PIBALS FROM THE FFTF SITE AND HMS, JUNE 24, 1970

FIGURE 5. Vertical Positions of Tetron Flights, June 24, 1970

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Wind directions from a northerly sector carried tetrons toward areas of high population on June 2, 17, and 26. The horizontal trajectory appeared to be without significant curvatures on all three days. Flight T2025, June 26, has some minor fluctuations but a comparison with oscillations of the vertical projection show these to be coincident with a very high rise of the tetron. A comparison of the directional changes of the tetron movement with the wind direction measured by the pibal released just prior to the tetron flight show the two to coincide. One can thus assume that the horizontal motions observed are a result of convective eddies carrying the tetron to a level with different wind directions. The vertical fluctuations of the tetron grow in amplitude with increased surface heating on these dates. An example of the increasing amplitude of the tetron vertical motions is during the successive tetron flights on June 17.

LIGHT WINDS

The trajectories of air parcels during light and variable winds are important to the definition of the site meteorology because a high percentage of the winds at the FFTF Site fit this category and the trajectory is next to unpredictable. Trajectories of tetrons under light and variable winds would be an estimate of an air parcel trajectories and it could be assumed that similar paths would be taken by air parcels under similar meteorological conditions.

May 11 and June 19 were two days during which the winds were light and variable. June 19, pibal data shows the light wind speeds in the lower 600 m of the atmosphere. The FFTF Site pibal data indicates a

180° wind shift in this layer both on June 11 and June 19.

The horizontal projection of the trajectory of flight T2016 on June 11, Figure 6, shows that the tetraon remained within 1 km of the FFTF Site for about 85 min. The vertical projection, Figure 7, shows the complex convection that existed during that period.

The striking feature of the trajectories of this day is that the tetraon remained relatively close to the release point for such long periods of time. If one were to assume a standard growth rate for a contaminant released on a similar day with unstable air the air flow would be returning partially contaminated air to the source prior to moving the air parcels away from the source.

METEOROLOGICAL SUMMARIES

The meteorological summaries discussed show the percent frequency of wind direction vs. speed, direction vs. time of day, and the wind direction at one location vs. the simultaneous observation of wind direction at a second location. Some of these tables have been highlighted by an isopleth to assist in the evaluation of the salient features. A description of available updated HMS summarized meteorological data is in Appendix B. Appendix C contains the wind direction vs. speed, and wind direction and speed vs. time of day summaries for the individual months at the FFTF Site.

WIND DIRECTION VS. SPEED

Summaries of wind direction vs. speed are presented for the FFTF Site, HMS, and the 300N Site for a comparison of the wind velocity between months and between sites.

FIGURE 7. TETRON FLIGHT T2016, VERTICAL POSITIONS

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The FFTF Site wind direction and speed data are summarized for the months of December 1969 and June 1970 in Figure 8 and Table III for comparison of wind direction and speed changes from winter to summer. From the figure it may be determined that there are more variable and calm winds in June than December. The increase in calm winds during December is a significant feature of seasonal changes consistent with HMS summaries.* The higher frequency of 4 and 5 m/s winds during June occurred during the afternoon hours suggesting a diurnal effect of summer heating. Predominant wind direction frequencies changed significantly from June to December as seen in Figure 8 and Table III suggesting major wind direction changes from season to season. The most noticeable difference occurs in the frequency of westerly wind directions. The large frequency of June winds from the direction of 250° is absent during December and the high frequency of winds around 310° (NW) during December is lacking during June. Other variations are in the easterly wind directions which occur less frequently during December than in June and a shift of a peak wind direction frequency at 150° during June moved to 170° during December.

The FFTF and HMS wind direction and speed data from June 1970 are summarized in Figure 9 and Table IV as comparative data for the two locations. The differences in predominant wind directions are shown in Figure 9. The predominant 150° wind direction at the FFTF Site is not

*C. E. Jenne and R. E. Kerns, "A Climatological Study of the Hanford Area", HW-57722, Hanford Atomic Products Operation, Richland, Washington, November 30, 1959.

Figure 8 Percent Frequency Distribution of Wind Direction, Ft. Ste. December 1969 and June 1970

Percent Frequency of Occurrence, Wind Direction vs. Speed, FFTF Site,
December 1969 and June 1970

[illegible]

FIGURE 9 Percent Frequency Distribution of Wind Direction, FTF and HMS 50 ft Level, June 1970

Percent Frequency of Occurrence, Wind Direction vs. Speed,
FFTF Site and HMS (50 Ft), June 1970

[illegible][illegible]

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evident at the HMS which has its prevailing direction at 300° . It may also be observed from both Figure 9 and Table IV that the frequency of variable and calm winds is much greater at the FFTF Site. Table IV illustrates the difference of the wind velocity at the two locations. The higher wind speeds occur at the HMS, and the predominant direction of the high wind speeds is from $160-210^{\circ}$ at the FFTF Site and from $270-320^{\circ}$ at the HMS.

A comparison of the FFTF Site and the 300N Site data during the month of June 1970 shows a large difference between the winds at the two sites, Table V. The wind velocities at the 300N Site are stronger and the wind direction distribution is much more bimodal at the 300N Site than at the FFTF Site.

WIND DIRECTION vs. TIME OF DAY

The summary of wind direction vs. time of day at the FFTF Site shows a slight diurnal change in the summary of the entire data period, Table VI. The nighttime (1800-0300 PST) wind direction is centered around 300° . The daytime directions show almost no predominance of direction. There is a period of high percentages from wind direction 210° which represents the daytime diurnal wind flow. An analysis of the months December 1969, and June 1970 do not show this diurnal change.

WIND DIRECTION vs. WIND DIRECTION

The FFTF Site wind direction observations were compared to concurrent measurements made at the HMS, Sites 105 and 112. The wind direction changes across the Hanford Reservation are apparent by the

FREQUENCY OF OCCURRENCE, WIND DIRECTION vs. SPEED DURING 6/70 AT 300M
SPEED (M/S)

[illegible]

PERCENT FREQUENCY OF OCCURRENCE OF WIND DIRECTION VS SIFF, DURING 6/70 AT FTFE

[illegible]

Percent Frequency of Occurrence, Wind Direction vs. Time of Day,
FFTF Site, December 1969 - June 1970

[illegible]

frequency of deviations from the FFTF Site wind direction.

A summary of the FFTF Site wind direction vs. the wind direction at the HMS shows large direction differences during SW wind directions at the FFTF Site, Table VII. The wind directions are more westerly in direction at the HMS (this is clockwise curvature from the FFTF Site). As the wind direction at the FFTF Site becomes more northerly, the HMS winds are again more westerly, a counter-clockwise deviation from the observations at the FFTF Site. The wind direction from approximately 300° at the FFTF Site is the same at the HMS. Since the approximate orientation of the Rattlesnake Hills is also 300° , these differences may be assumed to be a terrain effect on airflow around the Rattlesnake Hills.

Wind direction comparisons of the FFTF Site with Sites 105 and 112 show these sites as having the wind directions shifted clockwise or counter-clockwise but not changing as the FFTF wind direction changes. Site 112 usually has a wind direction clockwise from that at the FFTF Site, Table VIII. A slight shift from this occurs at the 150° wind direction at the FFTF Site when the wind direction aligns fairly well. Site 105 wind directions are counter-clockwise from the FFTF Site a high percentage of the time, Table IX.

TEMPERATURE

Temperature measurements at and near the FFTF Site have provided valuable information about temperature differences across Hanford, but no summaries are available because measurements have been made on a spot check basis. Temperature measurements made with the aircraft mounted sensor

TABLE VII

Percent Comparison of Wind Directions Between Site FFTF and Site HMS

[illegible]

TABLE VIII

[illegible]

PERCENT COMPARISON OF WIND DIRECTIONS BETWEEN SITE 112 AND SITE 112

	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	VAR	CALC
110	.96	.88	.84	.80	.76	.72	.68	.64	.60	.56	.52	.48	.44	.40	.36	.32	.04	.01
120	.93	.85	.81	.77	.73	.69	.65	.61	.57	.53	.49	.45	.41	.37	.33	.29	.04	.07
130	.90	.82	.78	.74	.70	.66	.62	.58	.54	.50	.46	.42	.38	.34	.30	.26	.04	.10
140	.87	.79	.75	.71	.67	.63	.59	.55	.51	.47	.43	.39	.35	.31	.27	.23	.04	.14
150	.84	.76	.72	.68	.64	.60	.56	.52	.48	.44	.40	.36	.32	.28	.24	.20	.04	.17
160	.81	.73	.69	.65	.61	.57	.53	.49	.45	.41	.37	.33	.29	.25	.21	.17	.04	.20
170	.78	.70	.66	.62	.58	.54	.50	.46	.42	.38	.34	.30	.26	.22	.18	.14	.04	.23
180	.75	.67	.63	.59	.55	.51	.47	.43	.39	.35	.31	.27	.23	.19	.15	.11	.04	.26
190	.72	.64	.60	.56	.52	.48	.44	.40	.36	.32	.28	.24	.20	.16	.12	.08	.04	.29
200	.69	.61	.57	.53	.49	.45	.41	.37	.33	.29	.25	.21	.17	.13	.09	.05	.04	.32
210	.66	.58	.54	.50	.46	.42	.38	.34	.30	.26	.22	.18	.14	.10	.06	.02	.04	.35
220	.63	.55	.51	.47	.43	.39	.35	.31	.27	.23	.19	.15	.11	.07	.03	.00	.04	.38
230	.60	.52	.48	.44	.40	.36	.32	.28	.24	.20	.16	.12	.08	.04	.00	.00	.04	.41
240	.57	.49	.45	.41	.37	.33	.29	.25	.21	.17	.13	.09	.05	.01	.00	.00	.04	.44
250	.54	.46	.42	.38	.34	.30	.26	.22	.18	.14	.10	.06	.02	.00	.00	.00	.04	.47
260	.51	.43	.39	.35	.31	.27	.23	.19	.15	.11	.07	.03	.00	.00	.00	.00	.04	.50
270	.48	.40	.36	.32	.28	.24	.20	.16	.12	.08	.04	.00	.00	.00	.00	.00	.04	.53
280	.45	.37	.33	.29	.25	.21	.17	.13	.09	.05	.01	.00	.00	.00	.00	.00	.04	.56
290	.42	.34	.30	.26	.22	.18	.14	.10	.06	.02	.00	.00	.00	.00	.00	.00	.04	.59
 						

TABLE IX

PERCENT COMPARISON OF WIND DIRECTIONS BETWEEN SITE FFTF AND SITE 105

[illegible]

PERCENT COMPARISON OF WIND DIRECTIONS BETWEEN SITE FETF AND SITE 105

		SITE 105																VAR	CALM
		210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360		
	010	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.00	.00	.00	.05	.00	.05	.00	.00
	020	.00	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.05	.00	.00	.05	.12	.00	.00
	030	.00	.02	.00	.00	.00	.00	.02	.00	.00	.02	.00	.02	.00	.00	.00	.12	.27	.10
	040	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02	.02	.00	.00	.00	.02	.05	.02	.05
	050	.00	.00	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00
	060	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.12	.00	.00
	070	.02	.02	.00	.00	.02	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.00	.00	.10
	080	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.02	.00	.00	.00	.00	.00	.00
	090	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	100	.00	.05	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	110	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	120	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	130	.05	.12	.10	.05	.05	.05	.05	.02	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00
	140	.05	.12	.10	.05	.05	.05	.05	.02	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00
	150	.10	.12	.07	.00	.00	.10	.07	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	160	.10	.12	.10	.10	.12	.07	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	170	.07	.14	.10	.10	.12	.07	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	180	.07	.27	.14	.10	.12	.07	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	190	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SITE FFIP	200	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	210	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	220	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	230	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	240	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	250	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	260	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	270	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	280	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	290	.17	.14	.10	.17	.07	.14	.10	.02	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	300	.00	.05	.10	.02	.09	.46	.77	1.01	.73	.31	.29	.29	.14	.10	.12	.31	.29	.14
	310	.02	.07	.02	.10	.00	.10	.43	.77	.44	.53	.24	.29	.03	.17	.31	.39	.22	.05
	320	.02	.00	.00	.00	.00	.10	.22	.46	.46	.31	.24	.46	.36	.27	.17	.39	.17	.25
	330	.00	.00	.00	.05	.05	.02	.10	.20	.14	.07	.19	.22	.17	.24	.36	.65	.14	.05
	340	.00	.00	.00	.02	.00	.05	.05	.02	.10	.07	.07	.22	.17	.12	.23	.77	.17	.02
	350	.00	.00	.00	.00	.00	.05	.02	.12	.10	.14	.14	.02	.10	.10	.20	.56	.12	.00
	360	.00	.02	.05	.02	.02	.00	.00	.17	.07	.22	.12	.27	.12	.17	.03	.21	.11	.05
	VAR	.17	.41	.31	.17	.31	.46	.80	.68	.07	.24	.12	.19	.12	.07	.16	.36	1.04	.00
	CALM	.02	.07	.10	.17	.10	.07	.22	.27	.07	.14	.14	.17	.17	.19	.12	.39	.65	.19

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during tetron releases show that near the surface the FFTF Site was generally cooler than the HMS during June 1970. (Ref. Appendix A) Surface temperature measurements made during the summer of 1969 also show the temperature is cooler southeast of the HMS. The measurements, Table X, indicate that the surface temperature 8 miles SE of the HMS is frequently as much as 5°F cooler than the HMS. These spot checks indicate that the temperatures near the surface at the FFTF Site are cooler than those at the HMS.

CONCLUSIONS AND RECOMMENDATIONS

Special studies of trajectories and diffusion, and the meteorological summaries show the horizontal and vertical differences in the values of meteorological parameters measured at and above the surface. The tetron trajectory followed vertical convective motions consistent with temperature profiles and horizontal movement as described by the winds above the surface measured from pibals. The surface wind sensors indicated the tetron movement when the tetron was near the surface. The climatic studies show differences in wind velocity and temperature between the FFTF Site and the HMS indicating direct extrapolation of some parameters from the HMS data to the FFTF Site is not practical.

During stable and neutral lapse rates, the tetron trajectories showed characteristics of laminar air flow. The oscillations of the tetron were very small indicating little or no mixing. Similar trajectories would be expected during winter inversions which are stronger and last for longer periods of time.

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TABLE XSURFACE TEMPERATURE COMPARISONS, HMS AND 8 MILES SOUTHEAST OF THE HMS

<u>Test</u>	<u>HMS</u>	<u>Temperatures</u> (Deg. F)
		<u>8 mi SE</u>
U-84	56.5	54.8
U-85	59.4	58.8
U-86	53.6	52.1
U-87	67.6	55.7
U-88	70.3	64.0
U-89	74.5	68.5
U-90	70.7	63.1
U-91	54.1	52.4
U-92	53.8	46.9

The unstable periods moved the tetron in large convective cycles which would enhance diffusion. Higher concentrations of a diffusing material than those predicted would only be expected near an elevated source because of the looping of a plume. Changes in ground cover were associated with changes in the vertical oscillations of the tetron during similar lapse conditions as determined from the vertical temperature profiles. The mean horizontal trajectory is the result of the wind directions at many levels above the surface during unstable lapse rates. The light and variable wind velocities associated with an unstable atmosphere carried the tetron on an unpredictable trajectory which returned to the area near the source providing the possibility of releasing a pollutant into air already containing a diffuse concentration of the source effluent. Changes in the mean wind direction observed during successive tetron flights showed the possibility that a high concentration could reach an area of predicted lower concentrations. The successive tetron flights also showed the growth of vertical convection during the daytime hours.

The wind velocity, temperature, and humidity measurements above the surface provided data for comparisons of differences in parameter values between the FFTF Site and the HMS, as well as for analyzing the effects of wind direction and lapse rate changes with height on the tetron trajectory. The data showed that wind velocity differences above the surface frequently exist between the two locations. The temperatures measured showed that cooler temperatures exist in the area of the FFTF Site.

The meteorological wind velocity summaries for the FFTF Site, HMS, and other locations showed only slight diurnal wind changes, definite winter and summer differences, and large differences in wind velocity from site to site. The FFTF Site and the HMS are different in the maximum frequencies of high wind speeds and the associated direction, and the frequency of wind from a given direction. The evaluation of the concurrent wind direction measurements showed a change in wind direction at the FFTF Site was frequently associated with little change in direction at the HMS. The wind direction differences at Sites 105 and 112 as compared to the FFTF Site were not as large as at HMS.

The extrapolation of data over large distances similar to the separation of the FFTF Site and HMS on the Hanford Reservation to provide trajectory and diffusion estimates is expected to provide questionable results when the extrapolation is in either the horizontal or the vertical plane. The changes in meteorological parameters between sites show that the trajectories of an air parcel during periods of unstable lapse rate are dependent upon more than surface winds at the source or even an array of surface sensors around the FFTF Site. Wind velocities measured above the surface at the FFTF Site appear to extrapolate over about 10 kilometers explaining the horizontal movement of the tetroon. During the periods that the trajectory was near the surface, the changes in airflow from local terrain effects make the use of an array of wind sensors necessary to evaluate the airflow. The data summaries support these statements that extrapolation over long distances on the Hanford Reservation should not be done because of the terrain influence on the values of the parameters.

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There is a need for the special studies conducted during June to be rescheduled during winter months when lapse rates are more stable, with multiple releases to provide opportunities to observe changes in the vertical convection, and wind direction. The tests would indicate the simulated trajectories under stable conditions which last for more than a matter of minutes or hours. The terrain effects should be more visible during those periods because of the absence of convective cycles changing the altitude of the tetroon.

Continued spot checks of wind direction and temperature above the surface are necessary to provide the additional information for the evaluation of those parameters which affect the diffusion around the FFTF Site, and show the difference between the FFTF Site and the HMS. Data collection of surface meteorological parameters needs to be continued at the FFTF Site and in the surrounding area to provide definition of the on-site meteorology and changes that occur in the immediate area.

DISTRIBUTION

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APPENDIX A

Test Data

Tetroon Trajectories, Vertical Profiles of Temperature
and Humidity, and Pibal Winds

APPENDIX A

Test Data

Tetroon Trajectories, Vertical Profiles of Temperature and Humidity, and Pibal Winds

Tetroon positions and the associated meteorological observations made during late May, and June are illustrated as a summary of the data collected. Tetroon releases T2007 and T2008 had inadequate baseline information to make the necessary computations and are not included in the Appendix. Table A1 lists the number of tetroons, pibals and sets of vertical temperature and humidity profiles measured each day. Figures A1-A76 are of the horizontal and vertical projections of tetroon trajectories, the horizontal projection of the pibal positions, and the vertical profiles of temperature and humidity. The data are grouped by date as indicated in the Table. For each test day tetroon trajectories are presented first, alternating mappings of the horizontal and vertical positions. All pibals for the day are grouped next, followed by the temperature and humidity profiles.

The horizontal positions of the tetroon were plotted each 5 or 10 minutes unless otherwise indicated, depending upon the proximity of the adjacent dots. The length of the trajectory was limited by the tracking time. Tracking was usually terminated after one theodolite team lost sight of the tetroon and could not recover sight of the tetroon.

The wind field for each test is shown on the map of horizontal positions of the tetroon by arrows aligned with the airflow. The arrows represent the three consecutive hours of wind direction data starting with

the hour prior to release. The half arrowhead ($\longrightarrow$) represents the first hour, the open arrowhead ($\longrightarrow$) is the next hour, and the shaded arrowhead ($\longrightarrow$) indicates the last and third hour. When multiple hours had the same direction, combinations of the arrowhead were used. The letter M is used to indicate missing data, the letters C and V to represent calm and variable winds. The wind speed, in mph, for each hour is shown at the head of each arrow. If space did not permit this representation the speeds read from left to right, or top to bottom.

The vertical positions of the tetron are plotted each minute. The terrain heights below the tetron are represented by dots which assist in the analysis of terrain effects on the vertical motions of the tetron.

The meteorological data collected shows the wind velocity with height, and the vertical profiles of temperature and humidity. The wind velocity is obtained from the pibal data and illustrated by plotting the horizontal positions of the pibal each minute unless otherwise indicated. The orientation and length of a line between points is a measure of the average wind direction and speed between observations. The temperature and humidity profiles are plotted as a vertical projection. The temperature is plotted in degrees C and the humidity in relative units.

TABLE A1
RECORD OF FIELD TESTS

<u>Date</u>	<u>No. of Pibals</u>		<u>No. of Tetrooms</u> <u>FFTF</u>	<u>No. of</u> <u>A/C Data Collection</u> <u>Flights</u>
	<u>622R</u>	<u>FFTF</u>		
5/22/70	2	2	2	
5/27/70	2	2	1	
6/2/70	2	2	1	
6/5/70	2 ^{a,b}	3 ^{b,c}	2 ^{b,c}	
6/8/70	1	1 ^{b,c}		1
6/10/70	2	2	1	2
6/11/70	2	2	1	2
6/15/70	4	4	2	2 ^d
6/17/70	6	6	3	3 ^d
6/19/70	1 ^a	3	2	
6/22/70	3	3	2	
6/24/70	6 ^e	6 ^e	4	3
6/26/70	4	4	2	1
6/29/70	4	4	3	3

^aPibal missed

^bData not plotted

^cFurther orientation information necessary prior to calculation

^dHumidity measurements only, temperature sensor inoperative

^ePibal not plotted (1222 PST)

FIGURE A1. TETROON FLIGHT T2003
Horizontal Positions
May 22, 1970
Time of Release 1100 PST

• - Tetroon Position
15 - Time After Release in Minutes

1 km

FIGURE A2. TETROON FLIGHT T2003, VERTICAL POSITIONS

FIGURE A3. TETROON FLIGHT T2004
Horizontal Positions

May 22, 1970
Time of Release 1150 PST

• - Tetron Position
15 - Time After Release in Minutes

1 km

FIGURE A4. TETROON FLIGHT T2004, VERTICAL POSITIONS

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.1
2	344.4
3	509.7
4	667.8
5	826.0
6	975.4
7	1124.2
8	1274.1
9	1423.4
10	1572.8

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.1
2	344.4
3	509.7
4	667.8
5	826.0
6	975.4
7	1124.2
8	1274.1
9	1423.4
10	1572.8

FIGURE A5. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, MAY 22, 1970, RELEASE TIMES 1005 AND 1250 PST

FIGURE A6. TETROON FLIGHT T2005
Horizontal Positions

May 27, 1970
Time of Release 1125 PST

• - Tetroon Position
15 - Time After Release in Minutes

MAY 27, 1970

TIME OF RELEASE 1125 PST

x - Tetron Elevation (MSL)

• - Surface Elevation (MSL)

15 - Time After Release in Minutes

FIGURE A7. TETROON FLIGHT T2005, VERTICAL POSITIONS

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location: * HMS
• FFTF Site

Numbers Represent the Elapsed Time After Release (min)

N

A

0 500 1000
Meters

1033 PST

Release Location: * HMS
• FFTF Site

Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

1243 PST

FIGURE A8. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, MAY 27, 1970, RELEASE TIMES: 1033 AND 1243 PST

FIGURE A10. TETROON FLIGHT T2006, VERTICAL POSITIONS

FIGURE A11 SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 2, 1970 RELEASE TIMES 1000 AND 1205 PST

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	499.8
4	667.5
5	826.0
6	975.4
7	1154.7
8	1374.1
9	1423.4
0	1572.8

x HMS
 o FFTF Site
 Number represents the Elapsed Time after Release (min)

FIGURE A12. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 8, 1970, RELEASE TIMES: 1015 PST

FIGURE A13 VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY JUNE 3 1970 1000 102 PST

FIGURE A15. TETROON FLIGHT T2009, VERTICAL POSITIONS

FIGURE A16. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FTF SITE, JUNE 10, 1970, RELEASE TIMES 0910 AND 1145 PST

FIGURE A17. VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 10, 1970, 0740 - 0830 PST AND 1010 - 1100 PST

JUNE 11, 1970

TIME OF RELEASE 0915 PST

x - Tetron Elevation (MSL)

• - Surface Elevation (MSL)

15 - Time After Release in Minutes

Note: After Minute No. 26
tetron was above 1200 meters.

FIGURE A19. TETROON FLIGHT T2010, VERTICAL POSITIONS

FIGURE A20. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 11, 1970, RELEASE TIMES: 1000 AND 1145 PST

Vertical Profiles of Temperature

0730-0820 PST

Vertical Profiles of Humidity

Vertical Profiles of Temperature

1010-1100 PST

Vertical Profiles of Humidity

FIGURE A21. VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 11, 1970, 0730 - 0820 PST AND 1010 - 1100 PST

FIGURE A23. TETROON FLIGHT T2011, VERTICAL POSITIONS

FIGURE A25. TETROON FLIGHT T2012, VERTICAL POSITIONS

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	826.0
6	975.4
7	1124.7
8	1274.1
9	1423.4
10	1572.8

Release Location X HMS
 • FFTF Site
 Numbers Represent the Elapsed Time After Release (min)

FIGURE A26. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 15, 1970, RELEASE TIMES: 0928, 1110, 1155, AND 1355 PST

FIGURE A27. VERTICAL PROFILES OF HUMIDITY, JUNE 15, 1970, 0820 - 0910 PST AND 1100 - 1250 PST

FIGURE A28. TETROON FLIGHT T2013
Horizontal Positions
June 17, 1970
Time of Release 0502 PST

• - Tetraodon Position
15 - Time After Release in Minutes

1 km

FIGURE A29. TETROON FLIGHT T2013, VERTICAL POSITIONS

FIGURE A31. TETROON FLIGHT T2014, VERTICAL POSITIONS

FIGURE A33. TETROON FLIGHT T2015, VERTICAL POSITIONS

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	673.5
5	838.0
6	1002.4
7	1166.7
8	1331.1
9	1495.4
10	1659.8

0435 PST

Release Location: * HMS
 • FTTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	673.5
5	838.0
6	1002.4
7	1166.7
8	1331.1
9	1495.4
10	1659.8

0600 PST

Release Location: * HMS
 • FTTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	673.5
5	838.0
6	1002.4
7	1166.7
8	1331.1
9	1495.4
10	1659.8

0730 PST

Release Location: * HMS
 • FTTF Site
 Numbers Represent the Elapsed Time After Release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	673.5
5	838.0
6	1002.4
7	1166.7
8	1331.1
9	1495.4
10	1659.8

0855 PST

Release Location: * HMS
 • FTTF Site
 Numbers Represent the Elapsed Time After Release (min)

FIGURE A34. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FTTF SITE, JUNE 17, 1970, RELEASE TIMES: 0435, 0600, 0730, AND 0855 PST

FIGURE A35. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 17, 1970, RELEASE TIMES: 1225 AND 1335 PST

Vertical Profiles of Humidity

Vertical Profiles of Humidity

Vertical Profiles of Humidity

FIGURE A36. VERTICAL PROFILES OF HUMIDITY, JUNE 17, 1970, 0600 - 0650 PST, 0840 - 0920 PST AND 1140 - 1230 PST

FIGURE A38. TETROON FLIGHT T2016, VERTICAL POSITIONS

FIGURE A39. TETROON FLIGHT T2017
Horizontal Positions
June 19, 1970
Time of Release 1158 PST

• - Tetroon Position
15 - Time After Release in Minutes

1 km

FIGURE A40. TETROON FLIGHT T2017, VERTICAL POSITIONS

A44

PIBAL HEIGHT	
ELAPSED TIME	HEIGHT
(min)	(m)
1	44.4
4	9.0
5	8.6
6	9.5
7	11.4
8	1.7
9	14.3
0	57.8

PIBAL HEIGHT	
ELAPSED TIME	HEIGHT
(min)	(m)
4	9.0
5	8.6
6	9.5
7	11.4
8	1.7
9	14.3
0	57.8

Release Location X HMS
 Number of PIBALs released after release (m)

Release Location X HMS
 Number of PIBALs released after release (m)

PIBAL HEIGHT	
ELAPSED TIME	HEIGHT
(min)	(m)
4	44.4
5	9.0
6	8.6
7	9.5
8	11.4
9	1.7
0	14.3
	57.8

Release Location X HMS
 Number of PIBALs released after release (m)

FIGURE A41. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FTF SITE, JUNE 19, 1970 RELEASE TIMES 0922 1155 AND 1435 PST

FIGURE A42. TETROON FLIGHT T2018
Horizontal Positions
June 22, 1970
Time of Release 0925 PST

• - Tetraodon Position
15 - Time After Release in Minutes

FIGURE 143. TETRON FLIGHT T2018, VERTICAL POSITIONS

FIGURE A44. TETROON FLIGHT T2019
Horizontal Positions

June 22, 1970
Time of Release 1219 PST

• - Tetroon Position
15 - Time After Release in Minutes

FIGURE A45. TETROON FLIGHT 12019, VERTICAL POSITIONS

FIGURE A46. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 22, 1970, RELEASE TIMES 0910, 1110, AND 1325 PST

FIGURE A47. TETROON FLIGHT T2020
Horizontal Positions
June 24, 1970
Time of Release 0506 PST

- - Tetron Position
- 15 - Time After Release in Minutes

1 km

Richland Airport

V,C,C

3.5 Miles South

FIGURE A48. TETROON FLIGHT T2020, VERTICAL POSITIONS

FIGURE A49. TETROON FLIGHT T2021
Horizontal Positions

June 24, 1970

Time of Release 0801 PST

• - Tetroon Position

15 - Time After Release in Minutes

FIGURE A50. TETROON FLIGHT T2021, VERTICAL POSITIONS

FIGURE A52. TETROON FLIGHT T2022, VERTICAL POSITIONS

FIGURE A53. TETROON FLIGHT T2023
Horizontal Positions

June 24, 1970

Time of Release 1234 PST

- - Tetraon Position
- 15 - Time After Release in Minutes

1 km

FIGURE A54. TETROON FLIGHT T2023, VERTICAL POSITIONS

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	866.0
6	955.4
7	1124.7
8	1174.1
9	1423.4
10	1572.8

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	9.8
2	44.4
3	79.0
4	86.0
5	95.4
6	147.7
7	174.1
8	174.1
9	143.4
10	157.8

Release Location: HMS (cross), FFTF (dot)
 Number represents the Elapsed time after release (min)

Release Location: HMS (cross), FFTF (dot)
 Number represents the Elapsed time after release (min)

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	866.0
6	955.4
7	1124.7
8	1174.1
9	1423.4
10	1572.8

PIBAL HEIGHT	
ELAPSED TIME (min)	HEIGHT (m)
1	179.8
2	344.4
3	509.0
4	667.5
5	866.0
6	955.4
7	1124.7
8	1174.1
9	1423.4
10	1572.8

Release Location: HMS (cross), FFTF (dot)
 Number represents the Elapsed time after release (min)

Release Location: HMS (cross), FFTF (dot)
 Number represents the Elapsed time after release (min)

FIGURE A55 SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 24, 1970, RELEASE TIMES 0445, 0605 0745 AND 1000 PST

FIGURE A56. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 24, 1970, RELEASE TIMES: 1345 PST

FIGURE A57 VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY JUNE 20, 1970 0510 0810 PST

FIGURE A58. VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 24, 1970, 1110 - 1200 PST

FIGURE A60. TETROON FLIGHT T2024, VERTICAL POSITIONS

FIGURE A61. TETROON FLIGHT T2025
Horizontal Positions
June 26, 1970
Time of Release 1152 PST

• - Tetroon Position
15 - Time After Release in Minutes

1 km

FIGURE A62. TETROON FLIGHT T2025, VERTICAL POSITIONS

FIGURE A63. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 26, 1970, RELEASE TIMES: 0840, 1015, 1130, AND 1330 PST

FIGURE A64. VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 26, 1970, 0600 - 0700 PST

FIGURE A66. TETROON FLIGHT T2026, VERTICAL POSITIONS

FIGURE A67. TETRON FLIGHT T2027
Horizontal Positions
June 29, 1970
Time of Release 1039 PST
• - Tetron Position
15 - Time After Release in Minutes

A-71

FIGURE A68. TETROON FLIGHT T2027, VERTICAL POSITIONS

FIGURE A70. TETROON FLIGHT T2028, VERTICAL POSITIONS

FIGURE A71. SIMULTANEOUSLY RELEASED PIBALS FROM THE HMS AND FFTF SITE, JUNE 29, 1970, RELEASE TIMES: 0835, 0955, 1115, AND 1300 PST

0600-0650 PST

Vertical Profile of Humidity

(0840-0930 PST)

Vertical Profile of Humidity

FIGURE A72 VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 29, 1970 0600 - 0650 PST AND 0840 - 0930 PST

FIGURE A73 VERTICAL PROFILES OF TEMPERATURE AND HUMIDITY, JUNE 29, 1970, 1130 - 1220 PST

APPENDIX B
Hanford Meteorological Station
Data Summaries

APPENDIX B

Hanford Meteorological Station Data Summaries

Meteorological information has been summarized for select parameters from data collected at the Hanford Meteorological Station (HMS) and the associated tower. The period of record for the data is 1955-1969 unless otherwise specified in the description of the data summary. Each table has been summarized as an annual summary and as a monthly or seasonal summary. Where seasons are used, months are grouped together as follows:

December, January, February	Winter
March, April, May	Spring
June, July, August	Summer
September, October, November	Fall

Examples of the tables and charts are included at the back of this Appendix in Figures B-1 through B-9, or a similar format is referenced in the descriptive information.

A portion of the data is directly applicable to the FFTF site while other information should be applied only after judicious screening and analysis. Consultation with personnel in the Atmospheric Analysis Section, ARD, BNW is recommended while using this data to assist in the evaluation and analysis.

Parameters which are common to more than one table are defined as follows:

A DESCRIPTION OF NUMBERED TABLES WITH ALPHABETIC PREFIX:

A1. Distribution of Wind Speed - 200-Foot Level Vs. E. These tables show the joint frequency distribution between each whole mile-per-hour of average hourly wind speed and 14 class intervals of a stability parameter, E, tabulated in number of cases.

- The stability parameter, E, is defined as follows:

$$E = \frac{\Delta \bar{T} / \Delta z - \Gamma}{T} \quad (1)$$

where the term $\Delta \bar{T} / \Delta z - \Gamma$ is the difference between the existing temperature gradient and the dry adiabatic lapse rate, and T is the average temperature of a layer of thickness z, given in degrees above absolute zero.

Table A1 refers to three different E's. E1 is based on data at the 200 and 3-foot levels, E2 on 250 and 50-foot data, and E3 on 400 and 50-foot data. From equation (1), it follows that:

$$E1 = \frac{10152 (T_{200} - T_3 + 1.0638)}{T_{200} + T_3 + 919.4} \times 10^{-6} \quad (2)$$

$$E2 = \frac{10000 (T_{250} - T_{50} + 1.08)}{T_{200} + T_{50} + 919.4} \times 10^{-6} \quad (3)$$

$$E3 = \frac{5714 (T_{400} - T_{50} + 1.89)}{T_{400} + T_{50} + 919.4} \times 10^{-6} \quad (4)$$

where T is temperature in degrees F and the subscripts indicate height above the ground surface in feet. The factor 10^{-6} is common to all E's and is omitted from the class intervals used in table A1.

- A2. Average Hourly Temperatures. These averages (degrees F) are for 1/2-inch below the ground surface and levels 3, 50, 100, 200, 250, 300, and 400 feet above the ground surface. Included are 6-hourly averages at depths of 15 and 36 inches beneath the soil surface. An all hours average is included for all levels.
- A3. Hourly Distribution of Time Vs. Delta 3. These tables show the joint frequency distribution between each hour of the day (PST) and 13 class intervals of Delta 3 (difference between 400-ft. and 50-ft. temperatures in degrees F), tabulated in number of cases.

- A4. Delta 1 Vs. Delta 2, Delta 1 Vs. Delta 3, and Delta 2 Vs. Delta 3.
 The deltas represent temperature differences between specific height intervals as given in the introduction. These tables show the joint frequency distribution (tabulated in number of cases) between 4 class intervals of one delta and the same class intervals of the other. Included are (1) a linear and quadratic regression equation expressing one delta in terms of the other, and (2) a standard error of estimate.
- A5. Vertical Wind Shear. These tables compare both the hourly prevailing directions and hourly average speeds at the 50-ft. level with those at the 400-ft. level. There are 18 class intervals of wind direction and 9 of wind speed (mph). The former are in code as given in the introduction. Statistics presented are in both number of cases and percent.
- A7. This table is in 6 parts as follows:
1. 200-Foot Speed Vs. Direction for Delta 1 less than -1.1.
 2. 200-Foot Speed Vs. Direction for Delta 1 - 1.1 to 0.
 3. 200-Foot Speed Vs. Direction for Delta 1 over 0.
 4. 200-Foot Speed Vs. Direction for Delta 3 less than -1.9.
 5. 200-Foot Speed Vs. Direction for Delta 3 -1.9 to 0.
 6. 200-Foot Speed Vs. Direction for Delta 3 over 0.

Delta 1 and Delta 3 are temperature differences between height intervals as shown in the introduction. These are joint frequency distribution tables between each whole mile per hour of hourly average wind speed and the same class intervals of wind direction used in table A5. Data are tabulated in number of cases.

- A9. Average Hourly Wind Speeds for Six Elevations. The elevations range from 7 to 400 feet with averages given in miles per hour. Averages of all hours are also included.

- A10. This table is in 3 parts as follows:

1. Station Pressure, Sea Level Pressure, Dew Point.
2. Dry Bulb, Wet Bulb, Relative Humidity.
3. Sky Cover, Solar Radiation.

The tables give the hourly and all hours average of station pressure in inches, sea level pressure in millibars, dew point, dry bulb in degrees F, relative humidity in percent, sky cover in 10ths, and hemispheric solar radiation in langley (gm calories/cm²).

- B2. This table is in 9 parts as follows:

1. 50-Foot Wind Direction Vs. 50-Foot Wind Speed.
2. Hour Vs. 50-Foot Wind Speed.
3. Hour Vs. 50-Foot Wind Direction.
- 4-9. Same as above for 200 and 400-Foot winds.

These are all joint frequency distribution tables with data tabulated in number of cases for the same direction and speed class intervals as those used in table A5.

B4. 200-Foot Wind Speed Vs. Deltas.

This table is in 3 parts as follows:

1. 200-Foot Wind Speed Vs. Delta 1.
2. 200-Foot Wind Speed Vs. Delta 2.
3. 200-Foot Wind Speed Vs. Delta 3.

Each part is a joint frequency distribution between 9 class intervals of wind speed and 4 class intervals of delta. The latter are listed under the terms LL, SL, MI, and LI. They stand, respectively, for large lapse (greater than the dry adiabatic), small lapse, moderate inversion, and large inversion. Table B4 gives the temperature differences corresponding to each of these terms.

Data are tabulated in number of cases.

D1. Dry Bulb Temperature Vs. 50-Foot Wind Speed.

These tables show the distribution of wind speed (9 class intervals) for 5-degree increments of dry bulb temperature. The body of the table lists the composite total number of cases, but row and column totals are in percent.

D2-1 and D2-2. Dry Bulb Temperature Vs. Wet Bulb Temperature.

These tables show the distribution of wet bulb temperature by 5-degree increments for each 5-degree increment of dry bulb temperature. Tabular data in the body of the table are number of cases, but row and column totals are in percent.

A DESCRIPTION OF NUMBERED TABLES50. Frequency Distribution of Wind Direction Vs. Wind Speed During Hours of Precipitation.

These tables give the joint frequency distribution between 9 class intervals of wind direction and 9 class intervals of wind speed (50-ft. level) during hourly observations of precipitation in any form or intensity. Tabular data are composite number of cases each season, and for the entire 1960-69 summary period. The coding used for wind directions is given in the introduction.

51. Frequency Distribution of Wind Direction Vs. Wind Speed During Hours of Fog with Visibility Less than 5/8 Mile.

These tables are similar in appearance to Table 50 and are prepared as above except that the wind direction and speed distribution is for hourly observations of fog sufficiently thick to restrict visibility to 1/2 mile or less. The summary period is 1960-69.

52. Dry Bulb Temperature Vs. Relative Humidity.

These tables show the distribution of relative humidity (6 class intervals) during 5-degree increments of dry bulb temperature. There is one table for each season and for the entire 1955-69 summary period. The body of the table lists the composite total number of cases, but row and column totals are in percent.

53. Percentage Frequency Distribution of Wind Speed and Wind Direction Vs. Atmospheric Stability.

These tables show the joint frequency distribution, in percent, between 6 class intervals of wind speed and 18 class intervals of wind direction, with each grouping broken down into four stability categories as follows: VS (very stable), MS (moderately stable), N (neutral), and U (unstable).

The tables are in three parts: one using D1 with 200-ft. wind, another using D2, also with 200-ft. wind, and a third using D6 with 400-ft. wind. The D's, together with the stability category determination for each, are explained below where T is temperature in degrees F, and the subscripts denote height above ground surface in feet.

	$D1 = T_{200} - T_3$	$D2 = T_{250} - T_{50}$	$D6 = T_{400} - T_{250}$
VS	≥ 3.5	≥ 3.5	≥ 2.5
MS	3.4 to -0.4	3.4 to -0.4	2.4 to -0.3
N	-0.5 to -1.4	-0.5 to -1.4	-0.4 to -1.1
U	≤ -1.5	≤ -1.5	≤ -1.2

There is one set of tables for each season and for the entire 1955-69 summary period.

54. Average Return Period (R) and Existing Record (ER) for Various Precipitation Amounts and Intensity During Specified Time Periods at Hanford. The table lists 7 time periods ranging from 20 minutes to 24 hours and 9 return periods ranging from 2 years to 1000 years. Precipitation data are given both in inches of total amount and in inches per hour and include existing records for each time period. Both the analysis and the existing records are based on 1947-69 records.

A DESCRIPTION OF CHARTS

1. Highest Temperature During Each of 57 Summers of Record at Hanford: 1912-69.

The data used for this chart are a composite of records kept by U. S. Weather Bureau cooperative observers near the old town of Hanford beginning in 1912, and those kept by plant personnel at the Hanford Meteorology Station beginning in 1945. A straight line is drawn through a plot of the data on probability paper - thus enabling an estimate of the probability that a given temperature will, or will not, be exceeded during the summer.

2. Lowest Temperature During Each of 58 Winters of Record at Hanford: 1912-13 to 1969-70.

This chart is prepared as described above except that the input is each winter's lowest temperature and is similar in appearance to Chart 1. Thus the straight line enables an estimate of the probability that the winter's lowest temperature will, or will not, be lower than a given temperature.

3. Greatest Depth of Snow on Ground During 24 of 25 Winters of Record: 1946-47 Through 1969-70.

A straight line drawn through a plot of these data on log probability paper enables an estimate of the probability that a given snow depth will, or will not, be exceeded during the winter.

4. Rainfall Intensity, Duration, and Frequency Based on the Period 1947-69 at Hanford.

This chart is the result of extreme value analysis of each year's maximum amount of rainfall during each of 6 time intervals: 60 minutes, 1 hour, 2 hours, 3 hours, 6 hours, and 12 hours. The chart shows 9 lines representing return periods ranging from 2 to 1000 years, and includes instructions for use.

5. Probability (%) that the First Hourly Observation of An Inversion Will Mark the Beginning of An Inversion Run of N Hours.

There are 4 of these charts with the months grouped as follows: (1) January-February, (2) March-April and May-June on the same chart, (3) July-August and September-October on the same chart, and (4) November-December. The input data consist of an analysis of consecutive hourly observations of inversion (temperature difference between 200-ft. and

3-ft. greater than 0) during the period 1952-69. A curve fitted to a plot of these data on log probability paper permits an estimate to be made of the probability that an inversion will, or will not, extend through a period of N consecutive hours, e.g., there is a 50% chance that during January and February, when an inversion first forms that it will last for 14 hours.

6. Probability (%) that the First Hourly Observation of a Superadiabatic Lapse Will Mark the Beginning of a Superadiabatic Run of N Hours.

There are 6 these charts with one curve on each chart representing months grouped as follows: (1) January-February, (2) March-April, (3) May-June, (4) July-August, (5) September-October, and (6) November-December. The charts are similar in appearance to Chart 5. The input data consist of an analysis of consecutive hourly observations when the decrease in temperature with height between 3 feet and 200 feet exceeded the dry adiabatic lapse rate (1.1°F). A curve fitted to a plot of these data on log probability paper enables an estimate of the probability that a superadiabatic lapse will, or will not, extend through a period of N consecutive hours.

TABLE A1 COMPOSITE DISTRIBUTION OF WIND SPEED - 200 FOOT LEVEL, VS. MONTH 1

200 FT SPEED	OVER 99.9	75.0 99.9	50.0 74.9	35.0 49.9	20.0 34.9	10.0 19.9	E1 INTERVAL 5.0 9.9	0.0 4.9	-5.0 -9.9	-10.0 -14.9	-20.0 -24.9	-30.0 -34.9	-45.0 -49.9	LESS -49.9	TOTALS
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

TABLE A2 COMPOSITE DISTRIBUTION OF WIND SPEED - 200 FOOT LEVEL, VS. MONTH 1

200 FT SPEED	OVER 99.9	75.0 99.9	50.0 74.9	35.0 49.9	20.0 34.9	10.0 19.9	E1 INTERVAL 5.0 9.9	0.0 4.9	-5.0 -9.9	-10.0 -14.9	-20.0 -24.9	-30.0 -34.9	-45.0 -49.9	LESS -49.9	TOTALS
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
46	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
47	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTALS	515	663	1205	1032	1622	1558	1109	1523	963	429	256	35	4	2	11154

TABLE A2 COMPOSITE AVERAGE MONTHLY TEMPERATURES MONTH 1

HOUR	3 FOOT ELEVATION			50 FOOT ELEVATION			100 FOOT ELEVATION		
	LOC, COS.	TEMP, °F	TEMP, °C	LOC, COS.	TEMP, °F	TEMP, °C	LOC, COS.	TEMP, °F	TEMP, °C
0	465	14372.1	26.07	465	14295.0	31.74	465	14391.3	31.55
1	465	14704.4	26.53	465	14264.2	31.85	465	14267.6	31.73
2	465	14164.8	26.41	465	14279.3	31.26	465	14166.6	31.51
3	465	14221.1	26.33	465	13921.7	29.94	465	14243.6	31.22
4	465	14016.8	27.72	465	13811.4	29.70	465	13938.3	29.67
5	465	14077.9	27.55	465	14071.2	29.40	465	13790.1	29.64
6	465	14077.9	27.37	465	14003.4	29.31	465	13750.3	29.56
7	465	14077.9	27.27	465	13951.3	29.16	465	13666.6	29.30
8	465	14077.9	26.35	465	13811.2	29.29	465	13651.6	29.37
9	465	14077.9	30.45	465	14044.6	31.33	465	13911.1	31.22
10	465	14077.9	32.20	465	14005.7	31.97	465	14071.6	31.55
11	465	14077.9	33.94	465	13961.6	31.91	465	14038.1	31.99
12	465	14077.9	35.7	465	14079.1	31.57	465	14000.9	31.11
13	465	14077.9	35.74	465	14070.6	31.41	465	14070.1	31.66
14	465	14077.9	36.22	465	14047.5	31.74	465	14089.6	31.6
15	465	14077.9	35.40	465	14044.1	31.43	465	14031.4	31.63
16	465	14077.9	33.76	465	14009.5	31.26	465	14022.7	31.33
17	465	14077.9	31.64	465	13977.6	31.50	465	14059.4	31.46
18	465	14077.9	30.95	465	14006.4	31.80	465	14033.5	31.93
19	465	14077.9	30.54	465	14092.5	31.46	465	14054.6	31.6
20	465	14077.9	31.6	465	14011.7	31.55	465	14088.6	31.23
21	465	14077.9	30.70	465	14075.2	31.77	465	14070.7	31.25
22	465	14077.9	29.34	465	14029.0	31.46	465	14020.4	31.87
23	465	14077.9	29.00	465	14070.5	31.12	465	14090.6	31.36
TOTAL	11154	341571.7	30.62	11154	359431.8	31.67	11154	359174.2	31.64

FIGURE B-1. Examples of Tables A1 and A2

HOUR	STATION PRESSURE			SEA LEVEL PRESSURE			DEW POINT		
	CBS,	TOTAL	AVE,	CBS,	TOTAL	AVE,	CBS,	TOTAL	AVE,
0	403	11012.29	29.311	403	41113.94	1021.134	403	6913.	22.1
1	403	11011.61	29.309	403	41116.66	1021.166	403	6804.	22.2
2	403	11010.93	29.307	403	41119.38	1021.199	403	6725.	21.9
3	403	11010.25	29.305	403	41122.10	1021.230	403	6707.	21.8
4	403	11009.57	29.303	403	41124.82	1021.260	403	6755.	21.6
5	403	11008.89	29.301	403	41127.54	1021.290	403	6811.	21.4
6	403	11008.21	29.299	403	41130.26	1021.320	403	6826.	21.4
7	403	11007.53	29.297	403	41132.98	1021.350	403	6899.	21.4
8	403	11006.85	29.295	403	41135.70	1021.380	403	6920.	21.7
9	403	11006.17	29.293	403	41138.42	1021.410	403	6937.	22.3
10	403	11005.49	29.291	403	41141.14	1021.440	403	6937.	23.4
11	403	11004.81	29.289	403	41143.86	1021.470	403	6967.	23.8
12	403	11004.13	29.287	403	41146.58	1021.500	403	6939.	23.9
13	403	11003.45	29.285	403	41149.30	1021.530	403	6901.	23.9
14	403	11002.77	29.283	403	41152.02	1021.560	403	6850.	24.0
15	403	11002.09	29.281	403	41154.74	1021.590	403	6840.	23.9
16	403	11001.41	29.279	403	41157.46	1021.620	403	6875.	23.8
17	403	11000.73	29.277	403	41160.18	1021.650	403	6858.	23.2
18	403	11000.05	29.275	403	41162.90	1021.680	403	6875.	23.0
19	403	10999.37	29.273	403	41165.62	1021.710	403	6840.	23.0
20	403	10998.69	29.271	403	41168.34	1021.740	403	6840.	23.0
21	403	10998.01	29.269	403	41171.06	1021.770	403	6840.	23.0
22	403	10997.33	29.267	403	41173.78	1021.800	403	6840.	23.0
23	403	10996.65	29.265	403	41176.50	1021.830	403	6840.	23.0
TOTAL	9672	243509.99	29.262	9672	946779.63	1020.240	9665	219512.	22.7

HOUR	SKY COVER			SOLAR RADIATION			RELATIVE HUMIDITY		
	CBS,	TOTAL	AVE,	CBS,	TOTAL	AVE,	CBS,	TOTAL	AVE,
0	403	11574.	28.0	403	10700.	26.7	403	31405.	78.1
1	403	11400.	27.0	403	10675.	26.5	403	31550.	78.3
2	403	11370.	26.8	403	10650.	26.3	403	31600.	78.5
3	403	11340.	26.6	403	10625.	26.1	403	31650.	79.2
4	403	11310.	26.4	403	10600.	25.9	403	31700.	79.5
5	403	11280.	26.2	403	10575.	25.7	403	31750.	79.8
6	403	11250.	26.0	403	10550.	25.5	403	31800.	80.0
7	403	11220.	25.8	403	10525.	25.3	403	31850.	80.4
8	403	11190.	25.6	403	10500.	25.1	403	31900.	80.5
9	403	11160.	25.4	403	10475.	24.9	403	31950.	78.0
10	403	11130.	25.2	403	10450.	24.7	403	32000.	75.1
11	403	11100.	25.0	403	10425.	24.5	403	32050.	74.7
12	403	11070.	24.8	403	10400.	24.3	403	32100.	67.3
13	403	11040.	24.6	403	10375.	24.1	403	32150.	64.8
14	403	11010.	24.4	403	10350.	23.9	403	32200.	64.1
15	403	10980.	24.2	403	10325.	23.7	403	32250.	64.7
16	403	10950.	24.0	403	10300.	23.5	403	32300.	66.5
17	403	10920.	23.8	403	10275.	23.3	403	32350.	71.7
18	403	10890.	23.6	403	10250.	23.1	403	32400.	73.7
19	403	10860.	23.4	403	10225.	22.9	403	32450.	74.7
20	403	10830.	23.2	403	10200.	22.7	403	32500.	75.6
21	403	10800.	23.0	403	10175.	22.5	403	32550.	76.7
22	403	10770.	22.8	403	10150.	22.3	403	32600.	76.9
23	403	10740.	22.6	403	10125.	22.1	403	32650.	77.6
TOTAL	9669	295422.	32.6	9670	271109.	28.0	9622	722415.	74.7

HOUR	SKY COVER			SOLAR RADIATION		
	CBS,	TOTAL	AVE,	CBS,	TOTAL	AVE,
0	403	1000.	7.0	403	0.	0.
1	403	1000.	7.0	403	0.	0.
2	403	1000.	7.0	403	0.	0.
3	403	1000.	7.0	403	0.	0.
4	403	1000.	7.0	403	0.	0.
5	403	1000.	7.0	403	0.	0.
6	403	1000.	7.0	403	0.	0.
7	403	1000.	7.0	403	0.	0.
8	403	1000.	7.0	403	0.	0.
9	403	1000.	7.0	403	0.	0.
10	403	1000.	7.0	403	0.	0.
11	403	1000.	7.0	403	0.	0.
12	403	1000.	7.0	403	0.	0.
13	403	1000.	7.0	403	0.	0.
14	403	1000.	7.0	403	0.	0.
15	403	1000.	7.0	403	0.	0.
16	403	1000.	7.0	403	0.	0.
17	403	1000.	7.0	403	0.	0.
18	403	1000.	7.0	403	0.	0.
19	403	1000.	7.0	403	0.	0.
20	403	1000.	7.0	403	0.	0.
21	403	1000.	7.0	403	0.	0.
22	403	1000.	7.0	403	0.	0.
23	403	1000.	7.0	403	0.	0.
TOTAL	9672	23500.	7.6	9636	001.57	0.003

FIGURE B-4. Examples of Table A10

TABLE B2 COMPOSITE 50 FOOT WIND DIRECTION VS. WIND SPEED MONTH 1											
DIR.	SPEED CLASS									TOTAL SPEED	AVE SPEED
	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	OVER 46		
1	220	0	40	16	11	2	0	0	0	1736	4.7
2	206	70	23	12	11	0	0	0	0	1396	4.3
3	149	53	5	3	1	0	0	0	0	629	3.0
4	194	69	1	3	0	0	0	0	0	612	2.9
5	237	85	17	0	1	0	0	0	0	1090	3.4
6	309	104	17	17	4	0	0	0	0	2115	4.3
7	183	60	37	30	16	5	0	0	0	1905	5.5
8	163	114	45	30	10	5	0	0	0	3086	7.6
9	137	115	75	113	67	39	10	1	0	6170	11.3
10	163	142	156	175	85	38	3	6	0	8152	10.8
11	165	162	181	75	42	17	2	0	0	5577	8.7
12	211	141	144	50	5	0	0	0	0	4040	6.1
13	274	573	506	106	5	4	0	0	0	10613	7.1
14	413	801	698	134	13	0	0	0	0	14259	6.9
15	335	208	57	10	3	0	0	0	0	2869	4.1
16	318	113	23	30	18	3	0	0	0	2186	4.4
17	146	16	6	0	0	0	0	0	0	282	1.6
18	583	0	0	0	0	0	0	0	0	0	0
TOTALS	4376	3142	2097	842	302	116	21	2	0	66919	6.1

TABLE B2 COMPOSITE HOUR VS. 50 FOOT DIRECTION MONTH 1																			
HOUR	DIRECTION INTERVAL																		SUM
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
0	15	5	5	11	11	13	11	8	2	37	24	33	78	71	18	17	7	22	418
1	15	4	0	0	10	13	11	10	3	31	25	32	71	70	17	15	4	13	412
2	15	4	0	0	10	13	11	10	3	31	27	26	73	70	19	17	5	29	421
3	9	9	3	7	10	13	11	10	3	31	31	36	56	63	15	11	18	26	421
4	14	9	1	7	10	13	11	10	3	31	31	34	62	92	24	9	28	465	
5	17	11	4	8	11	13	11	10	3	31	26	35	66	84	28	16	11	33	464
6	7	5	0	0	10	13	11	10	3	31	25	43	61	92	29	10	10	33	465
7	6	1	0	0	10	13	11	10	3	31	37	41	56	87	16	17	10	28	465
8	1	0	0	0	9	10	11	10	3	31	26	25	58	114	23	24	7	29	457
9	23	14	4	7	11	13	11	10	3	31	14	22	51	118	33	27	8	24	460
10	26	20	7	10	11	13	11	10	3	31	27	10	50	90	44	26	6	16	461
11	23	33	10	10	11	13	11	10	3	31	23	11	33	68	51	32	5	13	457
12	31	33	10	10	11	13	11	10	3	31	26	10	28	97	33	30	5	7	457
13	34	38	10	10	11	13	11	10	3	31	29	14	18	65	39	33	9	12	458
14	21	39	10	10	11	13	11	10	3	31	22	12	29	77	45	39	4	8	457
15	26	21	10	10	11	13	11	10	3	31	18	10	37	65	29	28	3	25	460
16	11	14	10	10	11	13	11	10	3	31	6	8	59	97	22	22	1	35	465
17	11	14	10	10	11	13	11	10	3	31	6	8	78	77	23	15	4	34	465
18	3	9	10	10	11	13	11	10	3	31	27	41	74	84	26	18	3	35	465
19	6	9	10	10	11	13	11	10	3	31	44	41	75	92	17	10	5	25	464
20	9	9	10	10	11	13	11	10	3	31	40	38	69	75	30	16	2	29	455
21	10	9	10	10	11	13	11	10	3	31	24	28	49	61	25	8	11	26	455
22	16	6	6	6	6	6	10	4	23	23	43	35	39	63	20	17	5	32	458
23	11	10	9	10	11	13	11	10	3	31	28	44	92	62	22	15	4	23	457
TOTAL	309	323	611	276	310	535	345	406	547	757	644	657	1498	2082	693	582	158	563	10882

TABLE B2 COMPOSITE HOUR VS. 50 FOOT WIND SPEED MONTH 1											
HOUR	SPEED CLASS									TOTAL SPEED	AVE SPEED
	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46	OVER 46		
0	179	92	91	37	7	4	2	0	0	2450	6.4
1	17	11	0	0	0	0	0	0	0	280	6.3
2	17	11	0	0	0	0	0	0	0	280	6.1
3	179	92	91	37	7	4	0	0	0	2650	6.1
4	175	109	97	25	0	0	0	0	0	2699	5.8
5	181	100	82	27	0	0	0	0	0	2630	5.7
6	203	105	60	24	0	0	0	0	0	2186	5.6
7	203	105	60	24	0	0	0	0	0	2033	5.4
8	200	107	78	20	0	0	0	0	0	2493	5.5
9	217	123	77	27	0	0	0	0	0	2531	5.5
10	210	120	60	24	0	0	0	0	0	2705	5.9
11	210	120	60	24	0	0	0	0	0	2920	6.4
12	210	120	60	24	0	0	0	0	0	3095	6.6
13	210	120	60	24	0	0	0	0	0	3100	6.6
14	210	120	60	24	0	0	0	0	0	3095	6.6
15	210	120	60	24	0	0	0	0	0	2844	6.2
16	210	120	60	24	0	0	0	0	0	2854	6.2
17	210	120	60	24	0	0	0	0	0	2988	6.4
18	210	120	60	24	0	0	0	0	0	3129	6.7
19	210	120	60	24	0	0	0	0	0	3129	6.7
20	210	120	60	24	0	0	0	0	0	2969	6.5
21	174	130	95	31	0	0	0	0	0	2854	6.3
22	164	124	113	33	0	0	0	0	0	2752	6.3
23	182	139	80	36	7	0	0	0	0	2759	6.3
TOTALS	4376	3142	2097	842	302	116	21	2	0	66919	6.1

TABLE B4... COMPOSITE 200 FT WIND SPEED VS. DELTAS		MONTH 1					
200 FT WIND SPEED VS DELTA 1		SPEED CLASS					
		LL	SL	M	U		
		UNDER	41.1	51.1	OVER	TOTAL	
		0-3	442	1320	1309	254	3354
	4 = 7	442	1320	1309	254	3354	
	8 = 12	442	1320	1309	254	3354	
	13 = 19	442	1320	1309	254	3354	
	19 = 24	442	1320	1309	254	3354	
	25 = 31	442	1320	1309	254	3354	
	32 = 38	442	1320	1309	254	3354	
	39 = 46	442	1320	1309	254	3354	
	OVER 46	442	1320	1309	254	3354	
		1	3	4	0	5	
TOTALS		1498	3144	5810	702	11194	

TABLE D2-2		CONCRETE DRY-BULB TEMPERATURE VS. ACT. BULB TEMPERATURE												MONTH		
DRY BULB		ACT. BULB TEMPERATURE												RCI, PCT.		
		45 / 49	50 / 54	55 / 59	60 / 64	65 / 69	70 / 74	75 / 79	80 / 84	85 / 89	90 / 94	95 / 99	100 / 104	105 / 109	G.T. / 109	PCT.
45 / 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.53
50 / 54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.14
55 / 59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.16
60 / 64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.33
65 / 69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.66
70 / 74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.59
75 / 79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.89
80 / 84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.97
85 / 89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.11
90 / 94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9.75
95 / 99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.96
100 / 104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21.29
105 / 109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15.55
G.T. / 109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10.40
45 / 49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.58
50 / 54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.92
55 / 59	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.16
60 / 64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.25
65 / 69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02
70 / 74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75 / 79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
80 / 84	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
85 / 89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90 / 94	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
95 / 99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100 / 104	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
105 / 109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G.T. / 109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
COG. PCT.	2.22	3.52	0.05	v.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
TOTAL OBSERVATIONS 9668																

FIGURE B-6. Examples of Tables D1 and D2

Table 50

COMPOSITE REPORT (1960 THROUGH 1969)
FREQUENCY DISTRIBUTION OF WIND DIRECTION VS. WIND SPEED
DURING HOURS OF PRECIPITATION

SEASON: SPRING

DIR.	SPEED CLASS										OVER 46	TOTAL
	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46				
1-2	12	18	9	2	2	0	1	0	0	0	0	44
3-4	17	25	7	1	0	0	0	0	0	0	0	50
5-6	32	39	21	4	0	0	0	0	0	0	0	96
7-8	15	38	32	9	6	0	0	0	0	0	0	100
9-10	12	46	49	40	18	6	2	0	0	0	0	167
11-12	20	65	61	38	17	5	3	1	0	0	0	210
13-14	15	71	144	62	21	5	0	0	0	0	0	318
15-16	19	40	22	8	2	0	0	0	0	0	0	91
17	0	0	0	0	0	0	0	0	0	0	0	0
18	46	0	0	0	0	0	0	0	0	0	0	46
TOTAL	188	336	345	104	66	16	6	1	0	0	0	1122

Table 51

COMPOSITE REPORT (1960 THROUGH 1969)
FREQUENCY DISTRIBUTION OF WIND DIRECTION VS. WIND SPEED
DURING HOURS OF FOG WITH VISIBILITY LESS THAN 5/8 MILE

SEASON: SPRING

DIR.	SPEED CLASS										OVER 46	TOTAL
	0-3	4-7	8-12	13-18	19-24	25-31	32-38	39-46				
1-2	1	0	0	0	0	0	0	0	0	0	0	2
3-4	1	0	0	0	0	0	0	0	0	0	0	1
5-6	0	0	0	0	0	0	0	0	0	0	0	0
7-8	0	0	0	0	0	0	0	0	0	0	0	0
9-10	0	0	0	0	0	0	0	0	0	0	0	0
11-12	0	0	0	0	0	0	0	0	0	0	0	0
13-14	3	6	0	0	0	0	0	0	0	0	0	9
15-16	2	1	0	0	0	0	0	0	0	0	0	3
17	0	0	0	0	0	0	0	0	0	0	0	0
18	3	0	0	0	0	0	0	0	0	0	0	3
TOTAL	10	8	0	0	0	0	0	0	0	0	0	18

Table 52

COMPOSITE REPORT (1957 THROUGH 1969)
DRY BULB TEMPERATURE VS. RELATIVE HUMIDITY

SEASON: SPRING

DRY BULB	RELATIVE HUMIDITY										ROW PCT.
	L.T. 30	30-44	45-59	60-74	75-89	G.T. 89					
L.T. 20	0	0	0	0	0	0	0	0	0	0	0
-2 / -10	0	0	0	0	0	0	0	0	0	0	0
-15 / -1	0	0	0	0	0	0	0	0	0	0	0
-1 / -0	0	0	0	0	0	0	0	0	0	0	0
-5 / -1	0	0	0	0	0	0	0	0	0	0	0
- / 4	0	0	0	0	0	0	0	0	0	0	0
5 / 9	0	0	0	0	0	0	0	0	0	0	0
1 / 14	0	0	0	0	0	0	0	0	0	0	0
15 / 19	9	7	13	9	2	5	0	0	0	0	0.17
2 / 24	11	21	31	25	20	14	0	0	0	0	0.44
25 / 29	13	30	44	123	111	58	0	0	0	0	1.27
3 / 34	20	25	201	348	306	113	0	0	0	0	3.53
35 / 39	41	115	654	606	453	135	0	0	0	0	6.98
4 / 44	57	410	1350	1000	583	238	0	0	0	0	12.76
45 / 49	94	1034	1717	974	459	225	0	0	0	0	15.67
5 / 54	379	1582	1733	737	243	131	0	0	0	0	16.73
55 / 59	619	1747	1764	315	164	36	0	0	0	0	13.81
6 / 64	917	1493	620	147	46	5	0	0	0	0	11.98
65 / 69	154	966	239	39	5	2	0	0	0	0	7.33
7 / 74	781	513	84	7	0	0	0	0	0	0	4.79
75 / 79	562	184	12	1	0	0	0	0	0	0	2.64
8 / 84	411	48	3	0	0	0	0	0	0	0	1.61
85 / 89	206	17	0	0	0	0	0	0	0	0	0.78
9 / 94	100	0	0	0	0	0	0	0	0	0	0.38
95 / 99	20	0	0	0	0	0	0	0	0	0	0.07
100 / 104	1	0	0	0	0	0	0	0	0	0	0.03
105 / 109	0	0	0	0	0	0	0	0	0	0	0
G.T. 109	0	0	0	0	0	0	0	0	0	0	0
CCL. PCT.	17.76	28.36	27.07	15.09	8.34	3.36					
TOTAL OBSERVATIONS											28704

Table 53

COMPOSITE REPORT (1957 THROUGH 1969) DURING FOG
PERCENTAGE FREQUENCY DISTRIBUTION OF WIND SPEED AND
WIND DIRECTION AT 200-FEET LEVEL VS. ATMOSPHERIC STABILITY

SEASON: SPRING

	VS	MS	NS	LS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
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FIGURE B-7. Examples of Tables 50, 51, 52 and 53

Table 54

AVERAGE RETURN PERIOD (R) AND EXISTING RECORD (ER) FOR VARIOUS PRECIPITATION AMOUNTS AND INTENSITY DURING SPECIFIED TIME PERIODS AT FANFORD

(BASED ON EXTREME VALUE ANALYSIS OF 1947-69 RECORDS)

R (YEARS)	AMOUNT (INCHES)								INTENSITY (INCHES PER HOUR)							
	TIME PERIOD								TIME PERIOD							
	20 MIN	60 MIN	2 HRS	3 HRS	6 HRS	12 HRS	24 HRS		20 MIN	60 MIN	2 HRS	3 HRS	6 HRS	12 HRS	24 HRS	
2	0.16	0.26	0.30	0.36	0.48	0.62	0.72		0.49	0.26	0.15	0.12	0.08	0.052	0.030	
5	0.24	0.40	0.48	0.55	0.77	0.95	1.05		0.72	0.40	0.24	0.18	0.13	0.079	0.044	
10	0.37	0.50	0.59	0.67	0.96	1.17	1.28		1.1	0.50	0.30	0.22	0.16	0.098	0.053	
25	0.47	0.62	0.74	0.83	1.21	1.45	1.55		1.4	0.62	0.37	0.28	0.20	0.121	0.065	
50	0.53	0.72	0.85	0.96	1.40	1.66	1.77		1.6	0.72	0.42	0.32	0.23	0.138	0.074	
100	0.60	0.81	0.96	1.07	1.59	1.87	1.99		1.8	0.81	0.48	0.36	0.27	0.156	0.083	
200	0.68	0.93	1.11	1.22	1.82	2.14	2.26		2.0	0.93	0.55	0.41	0.30	0.177	0.094	
500	0.73	1.02	1.22	1.33	2.00	2.34	2.47		2.2	1.02	0.61	0.44	0.33	0.195	0.103	
1000	0.80	1.11	1.33	1.45	2.20	2.55	2.68		2.4	1.11	0.67	0.48	0.37	0.212	0.112	
ER	*	0.59	0.88	1.08	1.68	1.88	1.91	*	0.59	0.44	0.26	0.28	0.157	0.080		
		6:12	10:1	10:1	10:1-2	10:1-2	10:1-2		6:12	10:1	10:1	10:1-2	10:1-2	10:1-2		
DATE		1969	1957	1957	1957	1957	1957		1969	1957	1957	1957	1957	1957		

* NO RECORDS HAVE BEEN KEPT FOR TIME PERIODS OF LESS THAN 60 MINUTES. HOWEVER, THE RAIN GAGE CHART FOR 6-12-69 SHOWS THAT 0.55 INCH OCCURRED DURING A 20-MINUTE PERIOD FROM 1835 TO 1855 PST. AN ADDITIONAL 0.04 INCH OCCURRED BETWEEN 1855 AND 1910 TO ACCOUNT FOR THE RECORD 60-MINUTE AMOUNT OF 0.59 INCH.

FIGURE B-8. Examples of Table 54

APPENDIX C
METEOROLOGICAL SUMMARIES
FFTF SITE

APPENDIX C
METEOROLOGICAL SUMMARIES
FFTF SITE

Summaries of the FFTF Site wind velocity data are presented by month for the period December 1969 through June 1970. The summaries are percent frequency distributions of wind direction vs. speed, wind direction vs. time of day, and wind speed vs. time of day.

[illegible]

RECEIVED CY OCEANIC TIRETYO 5' ELE, LUG 1/1 AT HFTF

[illegible]

PERCENT FREQUENCY OF OCCURRENCE, WITH INFECTION VS SIZE, DURING 2/70 AT FFTF

[illegible]

PERCENT FREQUENCY OF OCCURRENCE OF WIND DIRECTION & SPEED DURING 3/70 AT FTF

[illegible]

PERCENT FREQUENCY OF OCCURRENCE, BY DIRECTION VS SPEED DURING 4/70 AT FTF

	CALM	1	2	3	4	SPRN 5	(M/S) 6	7	8	9	10	11-12	13-14	15-16	17+
010	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
020	.00	.20	.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
030	.00	.40	.20	.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
040	.00	.60	.20	.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
050	.00	.80	.20	.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
060	.00	1.00	.20	.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
070	.00	1.20	.20	1.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
080	.00	1.40	.20	1.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
090	.00	1.60	.20	1.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
100	.00	1.80	.20	1.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
110	.00	2.00	.20	1.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
120	.00	2.20	.20	2.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
130	.00	2.40	.20	2.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
140	.00	2.60	.20	2.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
150	.00	2.80	.20	2.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
160	.00	3.00	.20	2.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
170	.00	3.20	.20	3.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
180	.00	3.40	.20	3.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
190	.00	3.60	.20	3.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
200	.00	3.80	.20	3.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
210	.00	4.00	.20	3.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
220	.00	4.20	.20	4.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
230	.00	4.40	.20	4.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
240	.00	4.60	.20	4.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
250	.00	4.80	.20	4.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
260	.00	5.00	.20	4.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
270	.00	5.20	.20	5.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
280	.00	5.40	.20	5.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
290	.00	5.60	.20	5.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
300	.00	5.80	.20	5.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
310	.00	6.00	.20	5.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
320	.00	6.20	.20	6.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
330	.00	6.40	.20	6.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
340	.00	6.60	.20	6.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
350	.00	6.80	.20	6.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
360	.00	7.00	.20	6.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
370	.00	7.20	.20	7.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
380	.00	7.40	.20	7.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
390	.00	7.60	.20	7.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
400	.00	7.80	.20	7.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
410	.00	8.00	.20	7.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
420	.00	8.20	.20	8.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
430	.00	8.40	.20	8.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
440	.00	8.60	.20	8.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
450	.00	8.80	.20	8.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
460	.00	9.00	.20	8.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
470	.00	9.20	.20	9.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
480	.00	9.40	.20	9.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
490	.00	9.60	.20	9.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
500	.00	9.80	.20	9.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
510	.00	10.00	.20	9.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
 
770	.00	15.20	.20	15.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
780	.00	15.40	.20	15.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
790	.00	15.60	.20	15.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
800	.00	15.80	.20	15.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
810	.00	16.00	.20	15.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
820	.00	16.20	.20	16.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
830	.00	16.40	.20	16.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
840	.00	16.60	.20	16.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
850	.00	16.80	.20	16.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
860	.00	17.00	.20	16.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
870	.00	17.20	.20	17.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
880	.00	17.40	.20	17.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
890	.00	17.60	.20	17.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
900	.00	17.80	.20	17.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
910	.00	18.00	.20	17.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
920	.00	18.20	.20	18.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
930	.00	18.40	.20	18.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
940	.00	18.60	.20	18.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
950	.00	18.80	.20	18.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
960	.00	19.00	.20	18.80	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
970	.00	19.20	.20	19.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
980	.00	19.40	.20	19.20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
990	.00	19.60	.20	19.40	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1000	.00	19.80	.20	19.60	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
1010	.00	20.00	.20	19.80	.00	.00	.00	.00	.00	.					

PLEASE T FREQUNCY OF OCCURRENCE, AND DIRECTION OF SET, ALONG 5/7. AT FIVE

[illegible]

	CALV	1	2	3	4	SPF ₁₀ (W/5)	6	7	8	9	10	11-12	13-14	15-16	1+
010	.00	.23	.09	.07	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
020	.00	.	.10	.	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
030	.00	.07	.01	.	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00
040	.00	.07	.27	.00	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00
050	.00	.04	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
060	---	.27	.00	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
070	.00	1.55	.23	.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
080	.00	1.01	.27	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
090	.	.	.01	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
100	.00	.01	.27	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
110	.00	1.	2.04	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
120	---	.07	.43	.10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
130	.00	.01	1.57	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
140	.	1.07	1.01	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
150	.00	1.	2.04	1.13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
160	.00	.01	.01	.08	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
170	.00	1.13	1.13	1.13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
180	.00	1.00	1.50	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
190	.	.	.07	.08	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
200	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
210	.00	.01	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
220	.00	.01	.27	.45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
230	.00	.00	.45	.27	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
240	.00	.00	1.13	.45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
250	.00	.00	1.26	1.13	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
260	.00	.00	.	1.01	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
270	.00	.00	.07	.45	.45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
280	.00	.00	1.01	1.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
290	.00	1.01	.00	.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
300	.00	.01	.01	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
310	---	.21	1.23	.45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
320	.00	.00	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
330	.00	.00	1.13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
340	.00	.00	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
350	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
360	.00	.00	.23	.23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
370	---	.27	1.53	.45	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
380	1.13	0.14	1.36	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
390	4.76	.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

PERCENT FREQUENCY OF OCCURRENCE OF WIND DIRECTION VS TIME OF DAY DURING 12/69 AT FFTF

[illegible]

PERCENT FREQUENCY OF OCCURRENCE, AND SPECIES VS TIME OF DAY DURING 12/69 AT FETE

		TIME OF DAY																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CAL	1	.32	.10	.08	.84	.48	.84	.64	.6	.32	.64	.48	.3	.48	.48	.64	.32	.32	.48	.32	.00	.22	.16	.48	.48
	1	1.43	1.77	1.29	1.45	1.45	1.93	1.45	1.61	1.61	1.64	1.77	1.03	2.05	2.57	2.25	2.89	2.89	2.73	2.25	1.77	2.25	1.61	2.89	1.29
	2	1.45	1.77	1.61	1.45	1.61	.96	1.61	1.61	1.61	1.13	.8	.00	.00	.96	1.29	.80	.96	.80	1.29	1.77	1.77	1.93	1.93	1.93
	3	.10	.16	.32	.00	.32	.16	.16	.5	.10	.16	.48	.64	.10	.32	.32	.16	.32	.48	.32	.48	.64	.16	.48	.48
	4	.48	.16	.16	.16	.16	.00	.00	.00	.48	.32	.16	.16	.16	.00	.00	.16	.16	.00	.16	.00	.00	.16	.00	.00
	5	.16	.16	.00	.00	.00	.00	.00	.00	.16	.00	.00	.00	.00	.00	.00	.00	.00	.16	.00	.00	.00	.00	.00	.00
	6	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	8	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	10	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	14	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	15	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	16	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	17	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	18	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	19	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	20	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	21	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	22	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	23	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	24	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TI-12	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
13-14	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
15-16	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
17+	1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00

PERCENT FREQUENCY OF OCCURRENCE BY WIND DIRECTION VS TIME OF DAY DURING 1/70 AT FETF

[illegible]

PERCENT FREQUENCY OF OCCURRENCE, WIND SPEED VS. TIME OF DAY DURING 1/70 AT FTF

[illegible]

- ENT FREQULCY OF OCCURENCE, WIND DIRECTION VS TIME OF DAY DURING 3/70 AT FIFT

[illegible]

PLATE FREQUENCY OF PLOJ FACE, IN SPERU VERTICAL OF CY DURING 3/7" AT FETE

[illegible]

PERCENT FREQUENCY IF OCCURRED, WITH DIRECTION, & TIME OF DAY DURING 4/70 AT FET.

[illegible]

PRECENT FREQUENCY OF OCCURRENCE, WIND SPEED VS TIME OF DAY DURING 4/70 AT FIFE

[illegible]

[illegible]

PERCENT FREQUENCY OF USE INCE, W* SPENT IN TITLE OF DAY DURING 5/70 AT FATH

		TIME DAY																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	1	2.76	2.74	2.61	2.51	2.20	1.76	1.77	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
	2	2.74	2.74	2.64	2.54	2.24	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74
	3	2.64	2.64	2.54	2.44	2.14	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
	 

SECRET - INFORMATION CONTAINED HEREIN IS UNCLASSIFIED EXCEPT WHERE SHOWN OTHERWISE

[illegible]

2 E T H R J F S O F C H I C A G O, I L I N O I S S P E C I A L T I P J F L A Y D U R I N G 6/70 T F F T F

		T1 - 1 DAY										T2 - 2 DAYS													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
GA-1	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
II-12	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	